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Balancer for an automatic washer
Auswuchtvorrichtung für eine automatische Waschmaschine
Dispositif d’équilibrage pour machine à laver automatique

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Description

The present invention relates to improvement in laundry machines and more particularly, to an improved balancing device for automatically correcting unbalance in rotors such as laundering machine wash drums which are spun at high speed to centrifugally extract fluid from laundered articles.

Description of Prior Art.

Centrifugal extraction is a commonly used expedient in laundering machines, especially in automatic home laundering machines, for the extraction of washing fluid from laundered articles after washing or rinsing period. Typically, at the termination of a laundering operation, the laudering container or wash drum is spun at high speeds for extracting the washing fluid from the laundered articles or clothes. A relatively high spinning speed is used for centrifugal extraction of the washing fluid from the washed clothes.

Frequently, however, the relatively heavy wet clothes are disposed within the wash drum in an unbalanced fashion creating an unbalanced condition during high speed spinning. The condition of having the load out of balance creates a condition where the center of mass of the rotating wash basket (with clothes load) does not correspond to the geometric axis of the wash basket. This leads to the generation of high loads and severe vibration of the wash basket. Furthermore, the severe vibration may cause the well known phenomenon of movement of the appliance across the floor. This unbalanced condition is particularly common in a wash drum having a horizontal axis, because the clothes load is more likely to gather on one side of the basket under the influence of gravity than in vertical axis washing machines.

Therefore, it is imperative that the wash basket be balanced to prevent excessive vibration and high loads. Correction of a wash basket unbalance, however, is frequently difficult as the location of the unbalance varies for each load and for each spin cycle and the amount of unbalance changes as fluid is extracted from the clothes.

One known method to overcome the above described problem and minimize the effect of the out-of-balance condition on the spinning wash drum is to secure to the wash drum heavy counter-balance weights. These counter-balance weights, usually large blocks of concrete or cast iron, are strapped to the outside of the rotatable drum for providing a fly wheel effect such that any unbalance due to uneven distribution of the clothes will be small relative to the mass of the counter-balance weights.

Another known method for overcoming the above described balancing problems is to utilize a movable liquid balancing system. For example, U.S. Patent 4,991,247 utilizes a system having a sensor for sensing an out-of-balance condition and having means for responding to the sensed out-of-balance condition by introducing liquid into a plurality of cavities disposed along the outer periphery of the wash drum such that the rotating wash drum may be balanced. Other liquid balancing systems include balancing disks wherein the liquid shifts under centrifugal force to correct the unbalance such as U.S. Patent 4,044,626.

DE-A-1,912,461 discloses an automatic balancing system for a laundry apparatus, comprising a single annular chamber partially filled with liquid arranged around the periphery of the end wall of a rotatable drum for receiving laundry.

Still another known movable liquid balancing system is disclosed in U.S. Patent 2,525,781, issued to De Remer on October 17, 1950, on which the preamble of claim 1 is based, and involves utilizing a plurality of concentric balancing disks, located across the periphery of a wash basket. This document teaches the use of three concentric balancing disks disposed around the outer periphery of a vertical axis wash basket. De Remer further teaches the relative movement of the balancing disk assemblies with regard to the rotatable wash basket. Several disadvantages, however, are present in the balancing apparatus disclosed by De Remer. Water extraction for the rotating wash basket is impeded by the balancing disks disposed around the periphery of the wash basket. Further, the inner diameter of the balancing disk assembly is restricted to be no less than the outer diameter of the rotatable wash basket, thus limiting the effective number of balancing disks utilised. These disadvantages are such that, despite the advantages provided, the balancing system disclosed by De Remer has not met with widespread commercial acceptance in the home laundry market.

According to the present invention, there is provided a laundry apparatus having a rotatable drum for receiving a clothes load, the rotatable drum having a geometric axis and further being capable of being subject to an out-of-balance mass, whereby a spinning axis distinct from the horizontal geometric axis is created, the rotatable drum further comprising: a generally cylindrical outerwall defining the geometric axis and having a predetermined diameter and a first end and a second end; a first disk for forming a first end wall of the rotatable drum and having an outer edge rigidly interconnected with the first end of the generally cylindrical outerwall; and a plurality of concentric annular chambers adapted to be partially filled with liquid so as to provide a balancing means for balancing the out-of-balance mass characterised in that the first disk includes the plurality of concentric chambers, the innermost annular chamber having an annular inner wall having an inner diameter substantially less than the predetermined diameter of the cylindrical outerwall.

In operation, the rotatable drum is subject to an out-of-balance mass as a result of uneven distribution of the clothes load within the drum. The out-of-balance mass
creates a spinning axis distinct from the horizontal geometric axis causing vibration during rotation. The fluid within the chambers, under the influence of centrifugal forces occurring during unbalanced rotation, is distributed within the chambers opposite the out-of-balance mass thereby partially correcting for the out-of-balance mass such that the difference between the geometric horizontal axis and the spinning axis, hereby called the eccentricity, is reduced.

The present invention provides a balancing system which maximises the restoring force generated for any given basket out-of-balance condition.

The present invention provides an apparatus for balancing a rotatable wash drum which may be relatively more sensitive to out-of-balance conditions than the aforementioned prior art.

The present invention provides a balancing system which may not impede water extraction from the clothes through the other periphery of the wash drum or cause pooling of water along the outer periphery of the wash drum.

The present invention provides a balancing system which may allow for a large opening into the drum for top loading horizontal axis washing machines.

The present invention provides a balancing system utilising a plurality of concentric fluid filled balancing disks having an optimum number of balancing disks which may be configured to not exceed the outer diameter of the rotatable wash drum.

Other advantages and features of the invention may become clear to those skilled in the Art from the following description of the preferred embodiment when taken in conjunction with the following drawings.

- Fig. 1 is a partially cut away side view of a laundry appliance embodying the principles of the present invention.
- Fig. 2 is an exploded, perspective view of the rotatable drum of Fig. 1.
- Fig. 3 is a partially cut away front view of the laundry appliance of Fig. 1.
- Fig. 4 is a diagrammatic view illustrating the action of an out-of-balance mass applied to the rotatable drum of the present invention.
- Fig. 5 is a diagrammatic view illustrating the action of a balancing disk having a plurality of fluid filled annular chambers responding to the presence of an eccentricity applied to the rotatable drum of the present invention.
- Fig. 6 is a diagrammatic view illustrating the action of a balancing disk having a single fluid filled chamber having a thickness equal to the sum of the thickness of the plurality of chambers of the balancing disk of Fig. 5 and responding to an equal eccentricity.
- Fig. 7 is a diagrammatic view illustrating the action of the balancing disk of Fig. 6 responding to a much greater eccentricity.
- Fig. 8 is a graph illustrating the relationship between the restoring force of a fluid balancing system and the number of annular chambers included in a fluid balancing system of the present invention.
- Fig. 9 is a detailed elevational top view of the main body of the balancing disk of Fig. 3.
- Fig. 9a is a sectional view of the main body taken along line 9a-9a of Fig. 9.
- Fig. 9b is a sectional view of the main body taken along line 9b-9b of Fig. 9.
- Fig. 10 is a detailed elevational view of the cover of the balancing disk of Fig. 3.
- Fig. 10a is a sectional view of the cover taken along line 10a-10a of Fig. 10.
- Fig. 11 is an elevational top view of the plug strip of the balancing disk of Fig. 3.
- Fig. 11a is an elevational side view of the plug strip of the balancing disk of Fig. 3.
- Fig. 12 is a detailed sectional view of the interconnection between the cylindrical outerwall and balancing disk of Fig. 3.

DESCRIPTION OF PREFERRED EMBODIMENT

In Fig. 1, there is illustrated a top-loading drum-type automatic washer embodying the principles of the present invention. The washer 1 has an outer cabinet 10 with an openable lid 11, shown in an open position, which encloses an imperforate wash tub 12 for receiving a supply of wash liquid. The wash tub 12 has an upwardly orientated access portion 16 and a wash tub lid 14, shown in an open position, disposed at the top of the access portion 16. A locking mechanism 18 is provided for maintaining the wash tub lid 14 in a closed and locked position during washing.

Disposed within the wash tub 12 is a rotatable, perforate wash drum 40 having an openable access door 42 for alignment with the access portion 16. The access door 42, shown in an open position, provides an opening 41 for allowing access into the wash drum 40 such that clothes may be loaded and unloaded from the wash drum 40.

The general construction of the rotatable drum 40 of the present invention is shown in Fig. 2, where it can be seen that the wash drum 40 is constructed of a cylindrical outer wall member 46, a first disk or balancing disk 44 and a second disk or balancing disk 48. The cylindrical outer wall defines a horizontal longitudinal axis of the wash drum 40 and includes a plurality of perforations or holes 47. The first balancing disk 44 is rigidly interconnected with a first end of the cylindrical outerwall member 46 to form a first end wall of the wash drum 40. The second balancing disk 48 is rigidly interconnected with a second end of the cylindrical outerwall member 46, opposite the first end, to form a second end wall of the wash drum 40. This construction of the wash drum 40 allows for adequate extraction of washing liquid during wash drum 40 spinning. Further, the balancing disks 44 48, being disposed along the ends of the perforate cylindrical outerwall member 46, do not prevent or ob-
struct the extraction of water through the plurality of perforations 47 in the outerwall 46. Preferably, the access door 42 may be proportioned to span across substantially the entire width of the cylindrical outerwall member 46 so as to maximize access into the interior of the wash drum.

A front view of the top loading automatic washer 1 embodying the principles of the present invention is shown in Fig. 3. A motor 24 is shown drivably connected to a pulley 22 by a belt 26. A drive shaft 37, rotatably supported by a first bearing means 30 interconnected with the wash tub 12, is provided having a first end drivingly connected to the pulley 22 and a second end drivingly connected to a first hub member 32. The first hub member 32 is rigidly connected to the first disk 44 of the rotatable wash drum 40 such that the motor 24 is drivingly interconnected with the wash drum 40. A second hub member 34, rigidly connected to the second disk 48 of the wash drum 40, is drivingly connected to a support shaft 38. The support shaft 38 is rotatable supported by a second bearing means 28 interconnected with the wash tub 12. This system, therefore, drivingly connects the motor 24 with the wash drum 40 and allows the drum 40 to rotate freely within the imperfect wash tub 12.

As shown in Fig. 2 and Fig. 3, the first balancing disk 44 and the second balancing disk 48 are configured to provide a plurality of annular concentric chambers 50. The annular concentric chambers 50 are defined by a plurality of annular concentric walls 52a, a first side wall 52b and a second side wall 70a. The chambers are further adapted to be partially filled with liquid. The balancing disks are constructed such that an innermost annular concentric wall 52c is disposed adjacent to an axially extending portion of the hub members 32 34. Further details of the preferred version of the balancing disk of the present invention are described further below. However, before describing details of the balancing disk construction, it is useful to discuss the action and benefits of the present balancing system.

Figs. 4, 5, 6, 7, and 8 illustrate the action and benefits of the present invention. Referring to Fig. 4, the rotatable wash drum 40 has a geometric center G corresponding to the longitudinal axis of the wash drum 40 and is configured to have a center of mass substantially identical to its geometric center G. The hubs 32 34 (Fig. 3) align with the geometric center G such that the wash drum 40 rotates about the geometric center G in an unloaded condition. As is well-known, in a rotating body alignment of the center-of-mass and the center of rotation is necessary for smooth rotation. However, an out-of-balance mass 60, due for example to an uneven distribution of clothes, may cause the true center-of-mass of the entire rotating body, including the wash drum 40 and its contents, to shift from rotating about its geometric axis G, to a new axis of rotation or spinning axis M. The separation distance between the two described axes is called the eccentricity. This condition will cause the well-known undesired vibration, with the severity of the vibration corresponding to the magnitude of the eccentricity. This unbalanced condition may be alleviated by the use of a plurality of fluid filled annular balancing chambers in a balancing disk. During unbalanced spinning, the fluid in the annular chambers recirculates to create an off-center fluid mass directly opposite the out-of-balance mass 60. This occurs because for speeds above the first critical frequency of the suspension system and with centrifugal accelerations higher than one gravitational acceleration, the rotating system consisting of the wash drum, the balancing disks and the out-of-balance mass, displaces in a direction 180 degrees out of phase with the unbalanced load. The fluid in the annular balancing chambers forms a free surface under the influence of centrifugal forces that is concentric with the spinning axis of the system. This action of the fluid tends to further reduce the unbalance condition and can substantially align the center-of-rotation with the geometric axis G, thereby substantially reducing vibrational amplitude. It should be noted, however, that some small out-of-balance condition will always be present in this type of rotating system in the presence of an out-of-balance mass because the fluid in the annular chambers reaches an equilibrium condition of distribution opposite the out-of-balance mass at a predetermined small out-of-balance condition.

Figs. 5, 6 and 7 may be used to illustrate the most effective configuration of a liquid balancing system and may help explain the increase in efficiency of liquid balancing action due to deliberate limitations of balancing chamber thickness and use of a plurality of chambers to obtain the necessary amount of corrective liquid mass. In Fig. 5 there is shown a balancing disk having a plurality of fluid-filled annular balancing chambers acting under the influence of an eccentricity E1, wherein the size of E1 is proportional to the vibrational amplitude created by the out-of-balance mass. The most effective correction action in the balancing disk takes place when the greatest relative shift of liquid in the balancing chambers occurs in response to an out-of-balance mass such that a maximum restoring force is provided. This occurs when the fluid in the balancing chambers has formed free surfaces concentric with the spinning axis M and have surfaces 62 tangent to the inner surface of the chambers and therefore are providing substantially the maximum restoring force to balance the rotary wash drum 40.

Fig. 6 shows a balancing disk having a single fluid filled balancing chamber having a substantially equal amount of fluid as the balancing disk shown in Fig. 5. In Fig. 6, the fluid is also acting under an out-of-balance mass creating the eccentricity E1 and has formed a free surface concentric with the spinning axis. It can be seen, however, that the fluid positioned inside the dotted line 64 forms a concentric ring around the center of rotation and does not constitute a counter-balancing effect. Only
the liquid positioned outside the dotted line 64 contributes a restoring force to correct the unbalanced condition. As it is readily seen, the restoring force, contributed by the fluid outside the dotted line 64, is significantly less than the restoring force contributed by the fluid in the balancing disks shown in Fig. 5. It is therefore evident, that for relatively small eccentricities, a single chamber balancing system having a relatively thick fluid filled balancing chamber does not provide effective corrective action at small vibrational amplitudes.

For a balancing disk having a single fluid filled chamber to contribute a substantially equal restoring force as a balancing disk having a plurality of annular fluid filled balancing chambers, a much greater eccentricity must occur. Fig. 7 shows a single balancing chamber contributing a substantially equal restoring force as the plurality of chambers shown in Fig. 5. In the single chamber construction as shown in Fig. 7, a relatively large eccentricity E2 must occur to cause the fluid in the single chamber to form a surface 66 tangent to the inner surface of the chamber. The vibrational amplitude corresponding to the relatively large eccentricity E2 would be relatively large and undesirable when compared to the vibrational amplitude corresponding to E1. In contrast, in the balancing system having a plurality of chambers as shown in Fig. 5, the relatively small eccentricity E1, caused the optimum fluid position for balancing thereby maintaining vibration amplitude of the rotating system at a preferred minimal level.

The benefit and increase in efficiency of liquid balancing action due to deliberate limitation of chamber thickness and use of a plurality of chambers is further illustrated in Fig. 8. Each chamber within a balancing disk substantially improves the effectiveness of the balancing disk where effectiveness is defined as the restoring force provided by the fluid in the chambers divided by the eccentricity present. However, assuming the outer radius and thickness of the disk remain the same, the improvement in effectiveness which occurs with each additional chamber is reduced by two factors. The first factor is that as the number of chambers rises because each additional chamber is added at a smaller radius such that less fluid is disposed in each additional chamber. The second factor is that the wall thickness between the chambers negatively impacts the effectiveness of the balancing disks as the number of chambers increases, because the wall thickness reduces the overall amount of fluid in the balancing disk.

In Fig. 8, these factors are taken into account and a typical plot of balancing disk effectiveness is shown where the ordinate represents the eccentricity caused by an out-of-balance mass and the abscissa represents the restoring force provided by the balancing disk system. As described above, it is preferable to obtain a maximum restoring force for a minimum eccentricity to minimize the vibrational amplitude of the rotating body. A plurality of plots are provide for various fluid filled balancing disks having a different number of chambers N.

It can be seen that for a balancing disk having one chamber (N=1), an eccentricity of 35mm is required prior to a restoring force of approximately 10000 Newtons. However, for a balancing system design having 8 chambers, an eccentricity of only 7mm is required for this same restoring force of 10000 Newtons. Further, for a balancing system having 12 chambers, an eccentricity of only 4mm provides a 8500 Newton restoring force. It is clear that for a typical balancing disk system there exists an optimum number of chambers as determined by a knee 66 in the plot which defines the general point of diminishing returns beyond which the maximum restoring force achieved is significantly reduced. An optimum number of chambers can therefore be determined by selecting a number in the region of the knee 66 of the plot.

Looking now at Fig. 9, Fig. 9a, Fig. 9b, Fig. 10, Fig. 10a, Fig. 11 and Fig. 11a, the details of the balancing disks 44 48 are further illustrated. In a preferred configuration, the balancing disks 44 48 include a main body 52, shown in Fig. 9, 9a and 9b, and a cover 70, shown in Fig. 10 and 10a.

The main body 52 is an integral member and includes the plurality of annular concentric walls 52a having end points 54 and the first side wall 52b. The main body further includes the innermost annular concentric wall 52c and an outermost annular concentric wall 52d. Furthermore, a plurality of baffle walls 52e are provided for modifying the flow of fluid within the concentric chambers 50 such that violent fluid flow within the balancing disk is prevented. An annular channel 56 disposed on the outermost annular wall 52d is provided for providing means for interconnecting the outerwall 46 with the main body 52 as further described below. An annular portion 55 is disposed between the innermost annular wall 52c and an annular hub positioning wall 59. Disposed within the annular portion 55 are a plurality of axially extending bosses 58 for interconnecting the main body 52 with the hub members 32 34 as further described below.

The cover 70 is an integral member and includes the second side wall 70a and a plurality of annular weld pads 74 corresponding to the end point 54 of the annular walls 52a. A plurality of fill holes 74 are provided in the cover. During assembly of the balancing disk 44, the weld pads 74 of the cover and the end points 54 of the main body are independently heated and then forcibly pressed together such that the main body 52 and the cover 70 are sealably welded together. The interconnected main body 52 and cover 70 comprise the balancing disks 44 48 and create the concentric annular chambers 50. These chambers may then be filled with balancing fluid though the fill holes 74 provided in the cover 70. A plurality of ribs 76 surround the fill holes 74.

Fig. 11 and 11a show a plug strip 80 for sealably plugging the holes in the cover 70. The plug strip includes a plurality of ribs 82 corresponding to the ribs 76 disposed in the cover 70. During assembly of the plug strip 80 and the cover 70, the ribs 76 of the cover and the ribs 82 of the plug strip are independently heated
and then forcibly urged together such that the cover and the plug strip 80 are sealably welded together after the chambers have had an adequate amount of fluid added and a leak test has been performed.

The assembled first balancing disk 44, including both the main body 52 and the cover 70, may then be interconnected with the cylindrical outerwall 46 and the hub members 32 34. As shown in Fig. 12, the annular channel 56 on the main body 52 is provided for fastening the cylindrical outerwall 46 securely to the balancing disk 44 wherein the outerwall 46 is forcibly urged into the channel 56 and locked in place. A plurality of radial ribs 57 are provided on the main body 52 for strengthening the main body such that support is providing during the operation of urging the outerwall 46 into the channel 56. The hub member 32 34 may be press fit into the opening defined by the annular hub positioning wall 59 of the main body 52. In addition, a plurality of screws 83 for securely fastening the hub members 32 34 to the balancing disks 44 48 are provided for insertion into the plurality of bosses 58 on the main body 52. As mentioned above, the hub members 32 34 receive and drivingly interconnect with the drive shaft 37 and the support shaft 38.

The above described configuration of a wash drum, therefore, provides a novel structure for providing balancing means to counteract an unbalanced mass in the wash drum. No balancing rings or mass are required to be disposed around the periphery of the wash drum. Therefore, wash liquid extraction may be readily achieved through the perforate cylindrical outerwall and further, the access door for the wash drum may have a preferable size and location. Additionally, the above described balancing system utilizes a balancing disk having an optimum number of concentric fluid filled chambers for balancing the wash drum. Finally, the above described disk construction is relatively cost effective and minimizes the total mass required for balancing the wash drum.

Although the present invention has been described with reference to a specific embodiment, those of skill in the Art will recognize that changes may be made thereto without departing from the scope of the invention as set forth in the appended claims.

Claims

1. A laundry apparatus (1) having a rotatable drum (40) for receiving a clothes load, said rotatable drum (40) having a geometric axis (G) and further being capable of being subject to an out-of-balance mass (60), whereby a spinning axis (M) distinct from said horizontal geometric axis (G) is created, said rotatable drum (40) further comprising:

   a generally cylindrical outerwall (46) defining said geometric axis (G) and having a predetermined diameter and a first end and a second end; 
   a first disk (44) for forming a first end wall of said rotatable drum (40) and having an outer edge rigidly interconnected with said first end of said generally cylindrical outerwall (46); and 
   a plurality of concentric annular chambers (50) adapted to be partially filled with liquid so as to provide a balancing means for balancing said out-of-balance mass (60)

characterised in that said first disk (44) includes said plurality of concentric chambers (50), the innermost said annular chamber having an annular inner wall (52c) having an inner diameter substantially less than the said predetermined diameter of said cylindrical outerwall (46).

2. A laundry apparatus according to claim 1, wherein each of said annular chambers (50) is defined by concentric annular inner and outer walls (52a) and substantially parallel side walls (52b, 70c).

3. A laundry apparatus according to claim 2, wherein said plurality of annular chambers (50) include baffling means (52e) such that violent fluid flow within said plurality of annular chambers (50) is prevented.

4. A laundry apparatus according to claim 2 or 3, further comprising:

   a motor (24) for rotatable driving said rotatable drum (40); 
   a rotatably supported drive shaft (37) drivingly interconnected with said motor (24); 
   a first hub means (32) drivingly interconnected with said drive shaft (37), said first hub means (32) having an outer surface; and 
   said annular inner wall (52c) of said innermost chamber of said first disk (44) being disposed around said outer surface of said first hub means (32) such that said first disk (44) is drivingly interconnected with said first hub means (32) for rotatably driving said rotatable drum (40).

5. A laundry apparatus according to any one of claims 2 to 4, wherein said plurality of concentric annular chambers (50) comprise at least five annular chambers (50).

6. A laundry apparatus according to any one of claims 2 to 5, wherein said first disk comprises:

   an integral main body (52) including a first side wall (52b) being a first one of said side walls defining said annular chambers (50); 
   a plurality of annular concentric walls (52a) ex-
tending substantially perpendicular from said first side wall (52b) and being said concentric inner and outer walls defining said annular chambers (50), said main body (52) being interconnected with said cylindrical outerwall (46) such that said main body (52) is oriented substantially perpendicular to the geometric axis (G), said main body (52) further having a center point substantially coincident with the geometric axis (G); and a cover (70) for sealably interconnecting with said integral main body (52) to form the second one of said sidewalls (70c) defining said annular chambers (50).

7. A laundry apparatus according to claim 6, wherein said cover (70) further comprises:

- a second annular side wall (70a);
- a plurality of annular weld pads (74) corresponding to said annular concentric walls (52a) of said integral main body (52) such that said annular weld pads (72) and said end points of said annular concentric walls (52a) may be independently heated and forcibly urged together, thereby sealably interconnecting said cover (70) with said integral main body (52); and
- a plurality of fill holes (74) disposed on said cover (70) such that one fill hole (74) corresponds to each annular chamber (50) for providing a means for filling each of said annular chambers (50) with an adequate amount of liquid.

8. A laundry apparatus according to any one of the preceding claims, wherein said generally cylindrical outerwall (46) is perforated such as to allow extraction of wash liquid during centrifuging.

9. A laundry apparatus according to any one of the preceding claims, wherein said rotatable drum further comprises a second disk (48) for forming a second end wall of said rotatable drum (40) and having an outer edge rigidly interconnected with said second end of said generally cylindrical outerwall (46).

10. A laundry apparatus according to claim 9, wherein said geometric axis (G) is horizontal, said rotatable drum (40) is disposed within a cabinet, said cabinet (10) having an openable lid (11) on a top surface for accessing said rotatable drum (40), and said generally cylindrical outerwall (46) further comprises:

- an opening (41) for alignment with said openable lid (11) said opening (41) further including an access door (42) for closing said opening (41) and being openable for allowing access into said rotatable drum (40).

11. A laundry apparatus according to claim 9 or 10, wherein said second disk (48) further comprises a second balancing means for balancing said out-of-balance mass (60).

12. A laundry apparatus according to claim 11, wherein said second balancing means of said second disk (48) further comprises a second plurality of concentric annular chambers (50), each chamber (50) being defined by concentric annular inner and outer walls (52a) and substantially parallel side walls (52b, 70c), said plurality of annular chambers (50) having an innermost chamber having an inner wall (52c), having an inner diameter less than said predetermined diameter of said generally cylindrical outerwall (46), each chamber further being adapted to be partially filled with liquid.

13. A laundry apparatus according to claim 12, wherein said second plurality of annular chambers (50) include baffling means (52e) such that violent fluid flow within said plurality of annular chambers (50) is prevented.

14. A laundry apparatus according to claim 12 or 13, further comprising:

- a second hub means (34) having an annular outer wall, said annular inner wall of said innermost chamber of said second disk (48) being disposed around said annular outer wall of said second hub (34) such that said second hub (34) and said second disk (48) are rigidly interconnected;
- a second rotatably supported support shaft (38) for rotatably supporting said rotatable drum (40), said second rotatably supported support shaft (38) being drivingly interconnected with said second hub means (34).

15. A laundry apparatus according to any one of claims 12 to 14, wherein said second plurality of annular chambers (50) comprise at least five annular chambers (50).

16. A laundry apparatus according to any one of claims 1 to 8, wherein said geometric axis (G) of said rotatable drum (40) is vertical so that said rotatable drum has a lower end being said first end and an upper end being said second end and being open for receiving a clothes load.

Patentansprüche

1. Waschmaschine (1) mit einer drehbaren Trommel (40) zur Aufnahme einer Waschgutcharge, wobei die drehbare Trommel (40) eine geometrische Achse (G) hat und einer Unwuchtmasse (60) ausge-
setzt sein kann, so daß eine von der waagerechten geometrischen Achse (G) verschiedene Umlaufachse (M) entsteht, und die Trommel weiterhin eine allgemein zylindrische Außenwandung (46), die die geometrische Achse (G) aufspannt und einen vorbestimmten Durchmesser sowie ein erstes und ein zweites Ende hat.

eine erste Scheibe (44), die die erste Stirnfläche am ersten Ende der drehbaren Trommel (40) bildet und mit einer Außenkante starr mit dem ersten Ende der allgemein zylindrischen Außenwand (46) verbunden ist, sowie eine Vielzahl von konzentrischen Ringkammern (50) aufweist, die als Gegengewicht für die Unwuchtmasse (60) teilweise mit Flüssigkeit gefüllt werden können,
dadurch gekennzeichnet, daß die erste Scheibe (44) die Vielzahl von konzentrischen Kammern (50) aufweist, von denen die innerste eine innere Ringwand (52c) mit einem Innendurchmesser aufweist, der erheblich geringer als der vorbestimmte Durchmesser der zylindrischen Außenwand (46).

2. Waschmaschine nach Anspruch 1, bei der jede der Ringkammern (50) von einer inneren und einer äußeren Wand (52a), die miteinander konzentrisch sind, sowie im wesentlichen parallelen Seitenwänden (52b, 70c) gebildet wird.

3. Waschmaschine nach Anspruch 2, bei der die Ringkammern (50) leitendrichtungen (52e) aufweisen, die heftige Strömungsstoße der Flüssigkeit in den Ringkammern (50) verhindern.

4. Waschmaschine nach Anspruch 2 oder 3 weiterhin mit einem Motor (24) zum Drehantrieb der drehbaren Trommel (40), einer drehbar gelagerten Antriebswelle (37), die zum Antrieb mit dem Motor (24) verbunden ist, und einer ersten Nabe (32), die zum Antrieb mit der Antriebswelle (37) verbunden ist und eine Außenfläche aufweist, wobei die innere Ringwand (52c) der inneren Kammer der ersten Scheibe (44) um die Außenfläche der ersten Nabe (32) herum so angeordnet ist, daß zum Drehantrieb der drehbaren Trommel (40) eine Antriebsverbindung von der ersten Nabe (32) zur ersten Scheibe (44) entsteht.

5. Waschmaschine nach einem der Ansprüche 2 bis 4, bei der mindestens fünf der konzentrischen Ringkammern (50) vorliegen.

6. Waschmaschine nach einem der Ansprüche 2 bis 5, bei der die erste Scheibe einen einstückigen Hauptkörper (52) mit einer ersten Seitenwand (52b) als erste der die Ringkammern (50) bildenden Seitenwände, eine Vielzahl von konzentrischen Ringwänden (52a), die im wesentlichen rechtwinklig von der ersten Seitenwand (52b) abstehen und die Ringkammern (50) bildenden konzentrischen inneren bzw. äußeren Wände darstellen, wobei der Hauptkörper (52) mit der zylindrischen Außenwand (46) so verbunden ist, daß er im wesentlichen rechtwinklig zur geometrischen Achse (G) und sein Mittelpunkt im wesentlichen auf der geometrischen Achse (G) liegen, sowie eine Abdeckung (70) zur dicht abgeschlossenen Verbindung mit dem Hauptkörper (52) aufweist, die die zweite (70c) der die Ringkammern (50) bildenden Seitenwände darstellt.

7. Waschmaschine nach Anspruch 6, bei der die Abdeckung (70) weiterhin eine zweite ringförmige Seitenwand (70a), eine Vielzahl von ringförmigen Schweißflächen (74) entsprechend den konzentrischen Ringwänden (52a) des Hauptkörpers (52) darstellt, daß die ringförmigen Schweißflächen (72) sowie die Enden der konzentrischen Ringwände (52a) getrennt erwärmt und dann aufeinander gedrückt werden können, um so die Abdeckung (70) dicht abschließend mit dem Hauptkörper (52) zu verbinden, sowie eine Vielzahl von Fülllöchern (74) aufweist, die in der Abdeckung (70) so angeordnet sind, daß jedes Füllloch (74) einer Ringkammer (50) entspricht, um die Ringkammern (50) mit einer ausreichenden Flüssigkeitsmenge füllen zu können.


10. Waschmaschine nach Anspruch 9, bei der die geometrische Achse (G) waagerecht liegt und die drehbare Trommel (40) im Gehäuse (10) angeordnet ist, das auf der Oberseite einen aufstellbaren Deckel
(11) zum Zugang zur Trommel (40) aufweist, wobei die allgemein zylindrische Außenwand (46) weiterhin eine Öffnung (41) enthält, die mit dem aufstellbaren Dekkel (11) ausrichtbar ist und mit einer Zugangstür (42) verschlossen sowie geöffnet werden kann, um Zugang ins Innere der Trommel (40) zu ermöglichen.

11. Waschmaschine nach Anspruch 9 oder 10, bei der die zweite Scheibe (48) weiterhin eine zweite Auswuchteinrichtung zum Ausgleichen der Unwucht (60) aufweist.

12. Waschmaschine nach Anspruch 11, bei der die zweite Auswuchteinrichtung der zweiten Scheibe (48) weiterhin eine zweite Vielzahl, konzentrischer Ringkammern (50) aufweist, die jeweils von konzentrischen inneren und äußeren Wänden (52a) sowie im wesentlichen parallelen Seitenwänden (52b, 70c) gebildet sind, wobei die Ringkammern (50) eine innere Kammer mit einer inneren Ringwand (52c) aufweisen, deren Innendurchmesser geringer ist als der vorbestimmte Durchmesser der allgemein zylindrischen Außenwand (46), wobei die Kammern jeweils teilweise mit Flüssigkeit gefüllt werden können.

13. Waschmaschine nach Anspruch 12, bei der die Ringkammern (50) der zweiten Vielzahl leit einrichtungen (52e) aufweisen, die heftige Strömungstoße der Flüssigkeit in den Ringkammern (50) verhindern.

14. Waschmaschine nach Anspruch 12 oder 13 weiterhin mit einer zweiten Nabe (34) mit einer umlaufenden Außenfläche, wobei die umlaufende Innenfläche der innersten Kammer der zweiten Scheibe (48) auf die umlaufende Außenfläche der zweiten Nabe (34) so aufgesetzt ist, daß die zweite Nabe (34) starr mit der zweiten Scheibe (48) verbunden wird, und einer drehbar gelagerten tragenden zweiten Welle (38), die die drehbare Trommel drehbar lagert und mit der zweiten Nahe (34) antrieblich verbunden ist.

15. Waschmaschine nach einem der Ansprüche 12 bis 14, bei der mindestens fünf Ringkammern (50) vorliegen.

16. Waschmaschine nach einem der Ansprüche 1 bis 8, bei der die geometrische Achse (G) der drehbaren Trommel (40) vertikal liegt, so daß die drehbare Trommel ein unteres Ende, das das erste Ende ist, sowie ein oberes Ende aufweist, das das zweite En-
moteur (24);
un premier moyen de moyeu (32) solidaire en entraînement avec ledit arbre d entraînement (37), ledit premier moyen de moyeu (32) ayant une surface extérieure; et

5 ladite paroi annulaire intérieure (52c) de ladite chambre située le plus à l intérieur dudit premier disque (44) étant disposée autour de ladite surface extérieure dudit premier moyen de moyeu (32), de manière telle que ledit premier disque (44) soit solidaire en entraînement avec ledit premier moyen de moyeu (32) de façon à entraîner en rotation ledit tambour rotatif (40).

Appareil lave-linge selon l'une quelconque des revendications 2 à 4, dans lequel ladite multitude de chambres annulaires concentriques (50) comprend au moins cinq chambres annulaires (50).

6. Appareil lave-linge selon l'une quelconque des revendications 2 à 5, dans lequel ledit premier disque comprend:

un corps principal monobloc (52) incluant une première paroi latérale (52b), constituant une première desdites parois latérales définissant lesdites chambres annulaires (50); plusieurs parois annulaires concentriques (52a) s étendant essentiellement perpendiculairement à partir de ladite première paroi latérale (52b), et constituant lesdites parois concentriques intérieures et extérieures définissant lesdites chambres annulaires (50), ledit corps principal (52) étant relié à ladite paroi cylindrique extérieure (46) de manière que ledit corps principal (52) soit orienté essentiellement perpendiculairement audit axe géométrique (G), ledit corps principal (52) comprenant en outre un centre qui, pour l essentiel, coïncide avec l axe géométrique (G); et un couvercle (70) destiné à être relié de façon étanche audit corps principal monobloc (52) de manière à former la seconde (70c) desdites parois latérales définissant lesdites chambres annulaires (50).

7. Appareil lave-linge selon la revendication 6, dans lequel ledit couvercle (70) comprend en outre:

une seconde paroi latérale annulaire (70a); plusieurs bossages annulaires de soudure (72) correspondant auxdites parois annulaires concentriques (52a) dudit corps principal monobloc (52), de manière que lesdits bossages de soudure (72) et lesdites arêtes desdites parois annulaires concentriques (52a) puissent être chauffés indépendamment les uns des autres et serrés les uns contre les autres de manière à sceller ledit couvercle (70) de façon étanche sur ledit corps principal monobloc (52); et plusieurs trous de remplissage (74) disposés dans ledit couvercle (70), de manière qu’un trou de remplissage (74) corresponde à chacune des chambres annulaires (50) de manière à permettre le remplissage de chacune desdites chambres annulaires (50) en une quantité appropriée de liquide.

8. Appareil lave-linge selon l'une quelconque des revendications précédentes, dans lequel ladite paroi extérieure globalement cylindrique (46) est perforée de manière à permettre l'extraction du liquide de lavage pendant la centrifugation.

9. Appareil lave-linge selon l'une quelconque des revendications précédentes, dans lequel ledit tambour rotatif comprend en outre un second disque (48) destiné à former la seconde paroi frontale dudit tambour rotatif (40) et présentant un bord extérieur rigide relié à ladite seconde extrémité de ladite paroi extérieure globalement cylindrique (46).

10. Appareil lave-linge selon la revendication 9, dans lequel ledit axe géométrique (G) est horizontal, ledit tambour rotatif (40) est disposé dans un carter, ledit carter (10) ayant un couvercle (11) ouvrant disposé à la surface supérieure de celui-ci, permettant d'accéder audit tambour rotatif (40), et dans lequel ladite paroi extérieure globalement cylindrique (46) comprend en outre une ouverture (41) prévue pour être alignée sur ledit couvercle ouvrant (11), ladite ouverture (41) comprenant en outre une trappe d'accès (42) permettant de fermer ladite ouverture (41) et pouvant être ouverte pour permettre l'accès à l'intérieur dudit tambour rotatif (40).

11. Appareil lave-linge selon la revendication 9 ou 10, dans lequel ledit second disque (48) comprend en outre un second moyen d'équilibrage destiné à compenser ladite masse (60) de balourd.

12. Appareil lave-linge selon la revendication 11, dans lequel ledit second moyen d'équilibrage dudit second disque (48) comprend en outre une seconde série de chambres annulaires concentriques (50), chacune des chambres (50) étant définie par des parois annulaires concentriques intérieure et extérieure (52a), et par des parois latérales essentiellement parallèles (52b, 70c), ladite série de chambres annulaires (50) comportant une chambre située le plus à l'intérieur, ayant une paroi annulaire intérieure (52c), présentant un diamètre intérieur inférieur audit diamètre prédéterminé de ladite paroi extérieure globalement cylindrique (46), chaque chambre étant d'autre part adaptée pour être partiellement...
ment remplie de liquide.

13. Appareil lave-linge selon la revendication 12, dans lequel ladite seconde série de chambres annulaires (50) comporte des moyens de chicane (52e), de manière à empêcher un écoulement violent de fluide à l'intérieur de ladite série de chambres annulaires (50).

14. Appareil lave-linge selon la revendication 12 ou 13, comprenant en outre:

- un second moyen de moyeu (34) ayant une paroi annulaire extérieure, ladite paroi annulaire intérieure de ladite chambre située le plus à l'intérieur dudit second disque (48) étant disposée autour de ladite paroi annulaire extérieure dudit second moyeu (34), de manière telle que ledit second moyeu (34) et ledit second disque (48) soient rigidement interconnectés;
- un second arbre de support (38) monté de façon rotative, destiné à supporter en rotation ledit tambour rotatif (40), ledit second arbre de support (38) étant solidaire en entraînement avec ledit second moyen de moyeu (34).

15. Appareil lave-linge selon l'une quelconque des revendications 12 à 14, dans lequel ladite seconde série de chambres annulaires (50) comprend au moins cinq chambres annulaires (50).

16. Appareil lave-linge selon l'une quelconque des revendications 1 à 8, dans lequel ledit axe géométrique (G) dudit tambour rotatif (40) est vertical, de manière que ledit tambour rotatif présente une extrémité inférieure constituante ladite première extrémité, et une extrémité supérieure constituante ladite seconde extrémité et étant ouverte afin de recevoir une charge de linge.